Water Monitoring Solutions

Water Quality Trends in Big Cypress Creek and Lake O' the Pines

Presented by:

Randy Rushin

Water Monitoring Solutions, Inc.

October 29, 2014


Water Monitoring Solutions
YSI
SonTek®
WATER LOG.
a xylem brand

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HUB Certified

Woman-Owned

Texas-Based

Small Business

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TEXAS COMPTROLLER of PUBLIC ACCOUNTS

P.O. Box 13186 • Austin, TX 78711-3186

The Texas Comptroller of Public Accounts (CPA) administers the Statewide Historically Underutilized Business (HUB) Program for the State of Texas, which includes certifying minority and woman-owned businesses as HUBs and is designed to facilitate the participation of minority and woman-owned businesses in state agency procurement opportunities.

We are pleased to inform you that your application for certification/re-certification as a HUB has been approved. Your company's profile is listed in the State of Texas HUB Directory and may be viewed online at http://www.window.state.tx.us/procurement//cmbl/hubonly.html. Provided that your company continues to meet HUB eligibility requirements, the enclosed HUB certificate is valid for four years.

You must notify the HUB Program in writing of any changes affecting your company's compliance with the HUB eligibility requirements, including changes in ownership, day-to-day management, control and/or principal place of business. *Note: Any changes made to your company's information may require the HUB Program to re-evaluate your company's eligibility.*

Please reference the enclosed pamphlet for additional resources, such as the state's Centralized Master Bidders List (CMBL), that can increase your chance of doing business with the state.

Thank you for your participation in the HUB Program! If you have any questions, you may contact a HUB Program representative at (512) 463-5872 or toll-free in Texas at (888) 863-5881.

Texas Historically Underutilized Business (HUB) Certificate

HUB
Statewide Historically Underutilized Business Program

Certificate/VID Number:	1202005435400
File/Vendor Number:	008919
Approval Date:	12-MAR-2013
Scheduled Expiration Date:	12-MAR-2017

The Texas Comptroller of Public Accounts (CPA), hereby certifies that

WATER MONITORING SOLUTIONS, INC.

has successfully met the established requirements of the State of Texas Historically Underutilized Business (HUB) Program to be recognized as a HUB. This certificate printed 15-MAR-2013, supersedes any registration and certificate previously issued by the HUB Program. If there are any changes regarding the information (i.e., business structure, ownership, day-to-day management, operational control, business location) provided in the submission of the business' application for registration/certification as a HUB, you must immediately (within 30 days of such changes) notify the HUB Program in writing. The CPA reserves the right to conduct a compliance review at any time to confirm HUB eligibility. HUB certification may be suspended or revoked upon findings of ineligibility.

Paul A. Gibson

Paul Gibson, Statewide HUB Program Manager
Texas Procurement and Support Services

Note: In order for State agencies and institutions of higher education (universities) to be credited for utilizing this business as a HUB, they must award payment under the Certificate/VID Number identified above. Agencies and universities are encouraged to validate HUB certification prior to issuing a notice of award by accessing the Internet (**http://www.window.state.tx.us/procurement/cmbl/cmblhub.html**) or by contacting the HUB Program at **1-888-863-5881** or **512- 463-5872**.

Rev. 09/12

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Highlights from the 2014 National Climate Assessment

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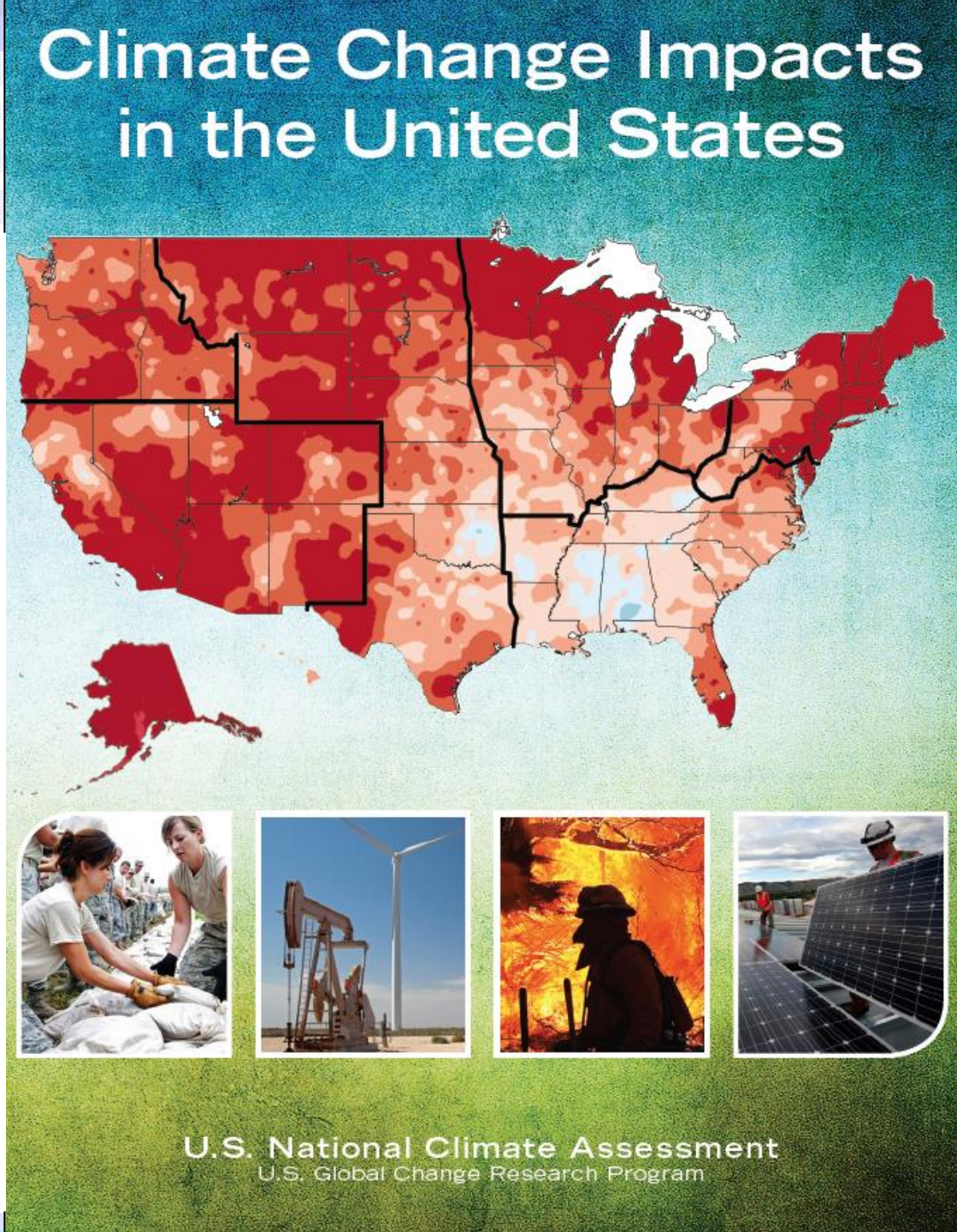
nca2014.globalchange.gov

- 3-Years
- >300 experts
- 60 Member Federal Advisory Committee
- >70 workshops
- Scientific expert review by National Research Council of the National Academy of Sciences.



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Climate Change Impacts

- Higher Temperatures
- Increased Energy Demand
- Increased Water Demand
- Less Annual Rainfall
- More Frequent & Intense Droughts
- Reduced Water Supply
- Increased Groundwater Demand & Subsidence

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Climate Change Impacts

- Higher Sea Levels/Greater Storm Surges
- More Extreme Events
- Reduced In-stream Flow
- Saltwater Intrusion
- Impaired Ecological/Biological Communities
- Economic (commercial & sport fisheries, tourism, industrial capacity)

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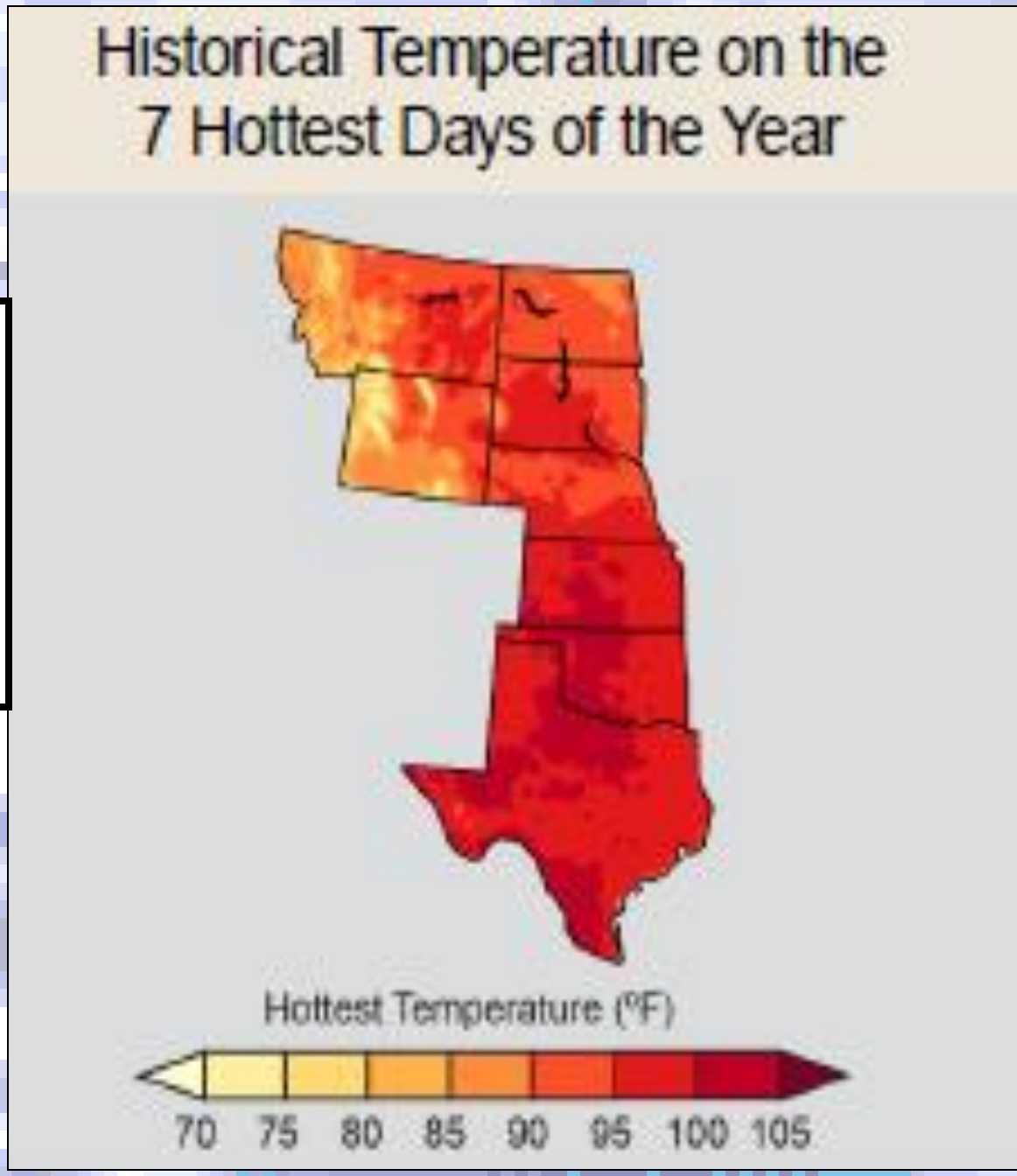
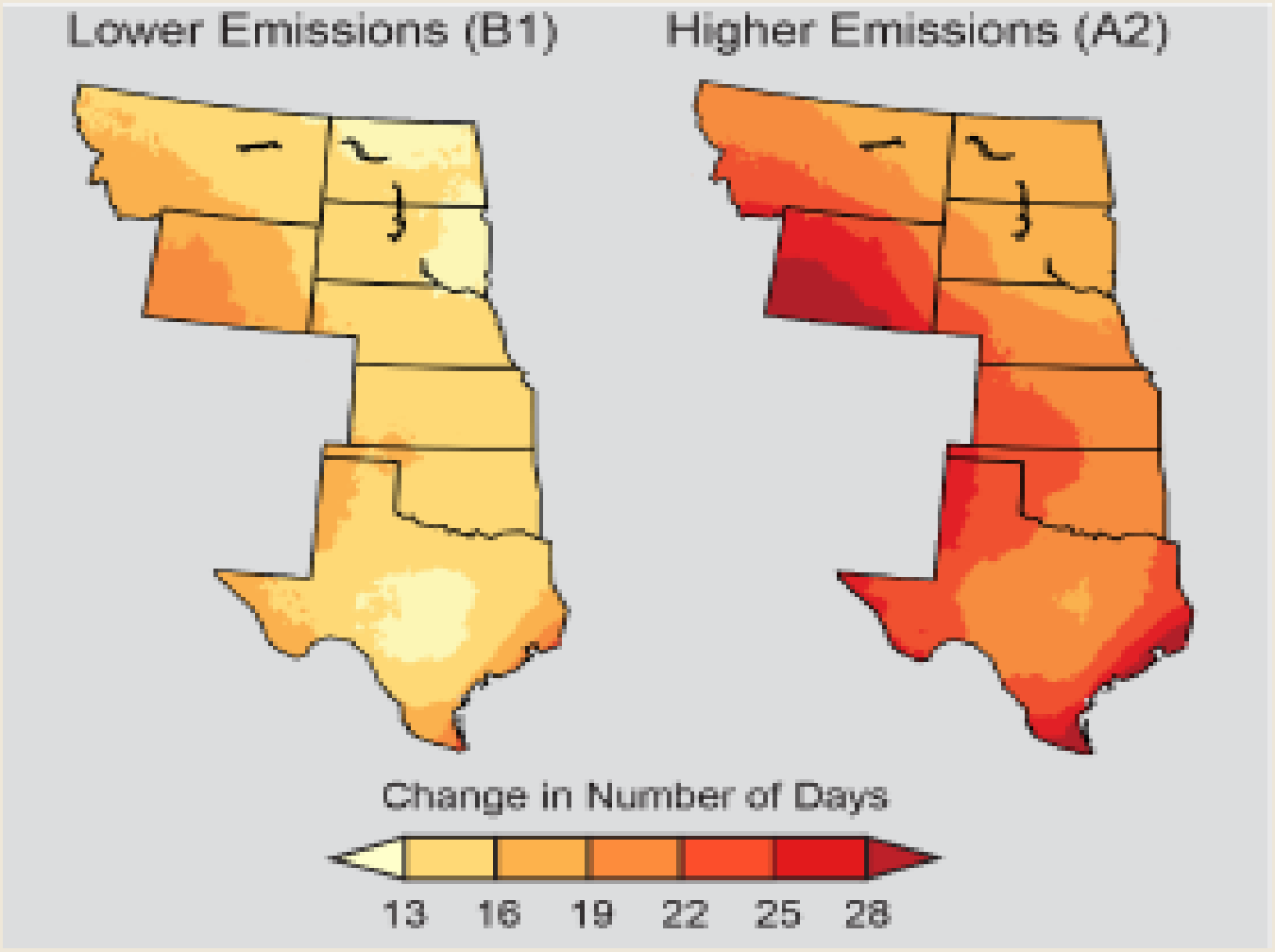
Historical Temperatures

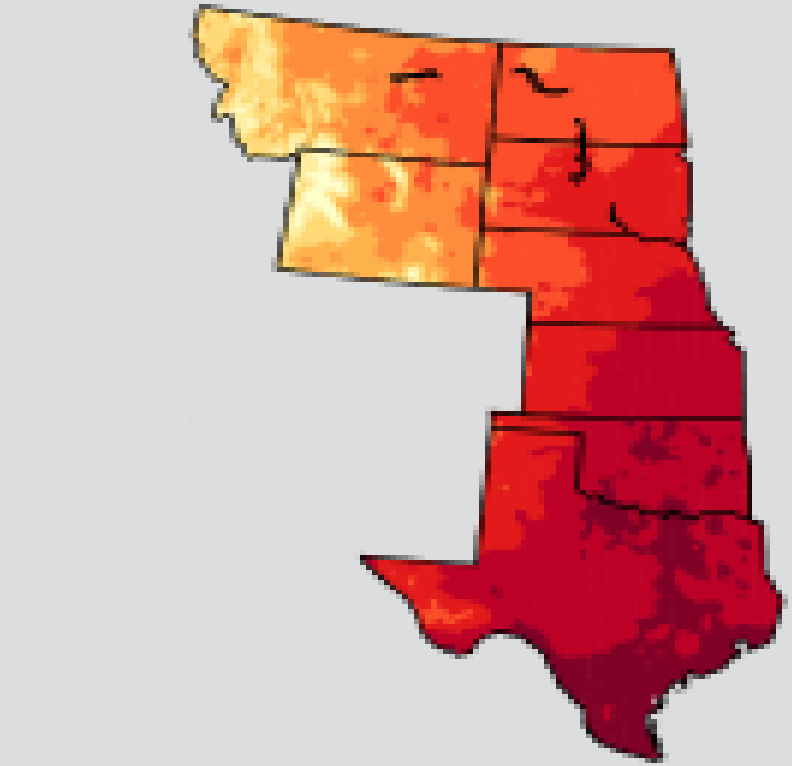


13-25 More Hot Days

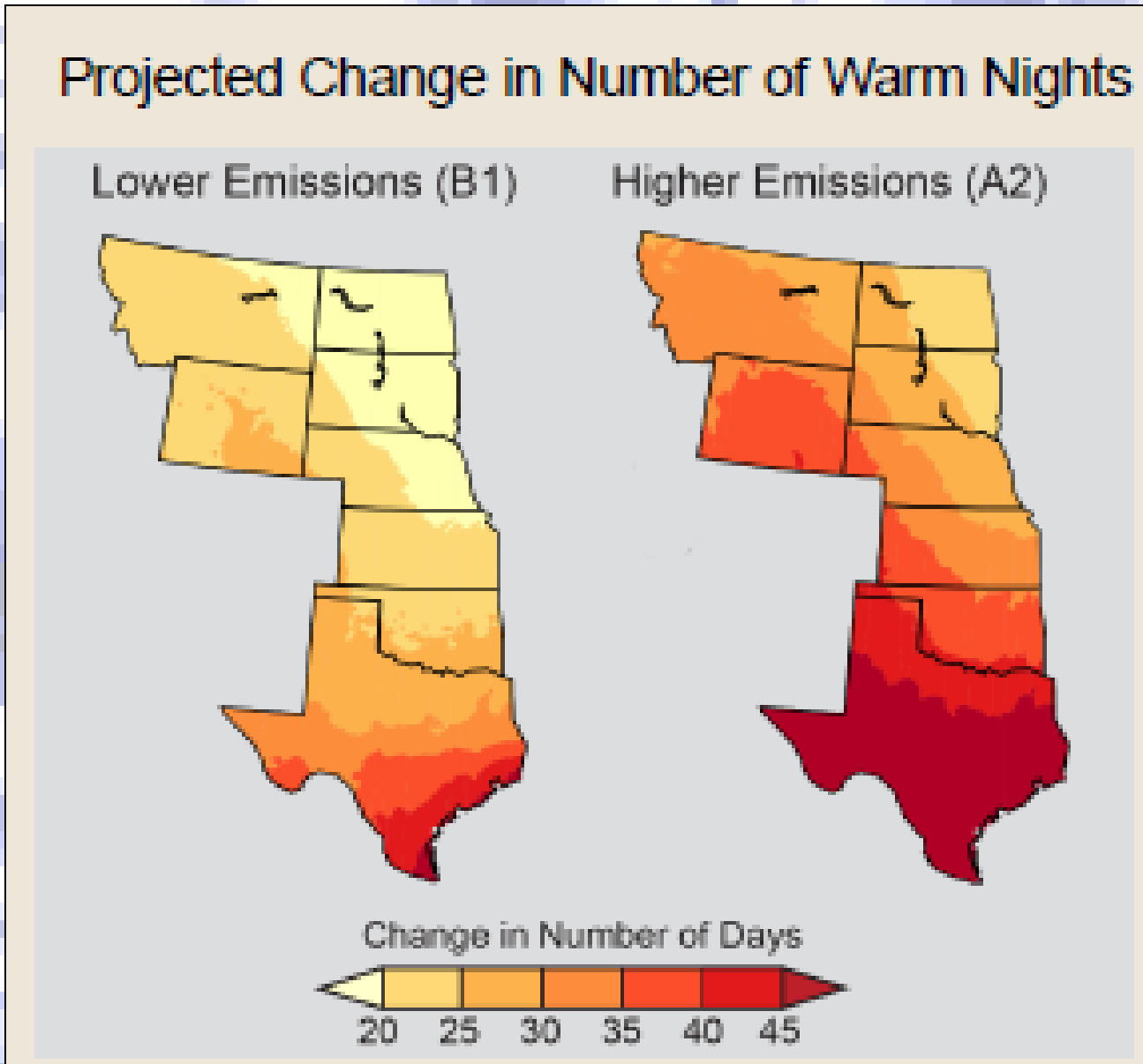
Projected Change in Number of Hot Days

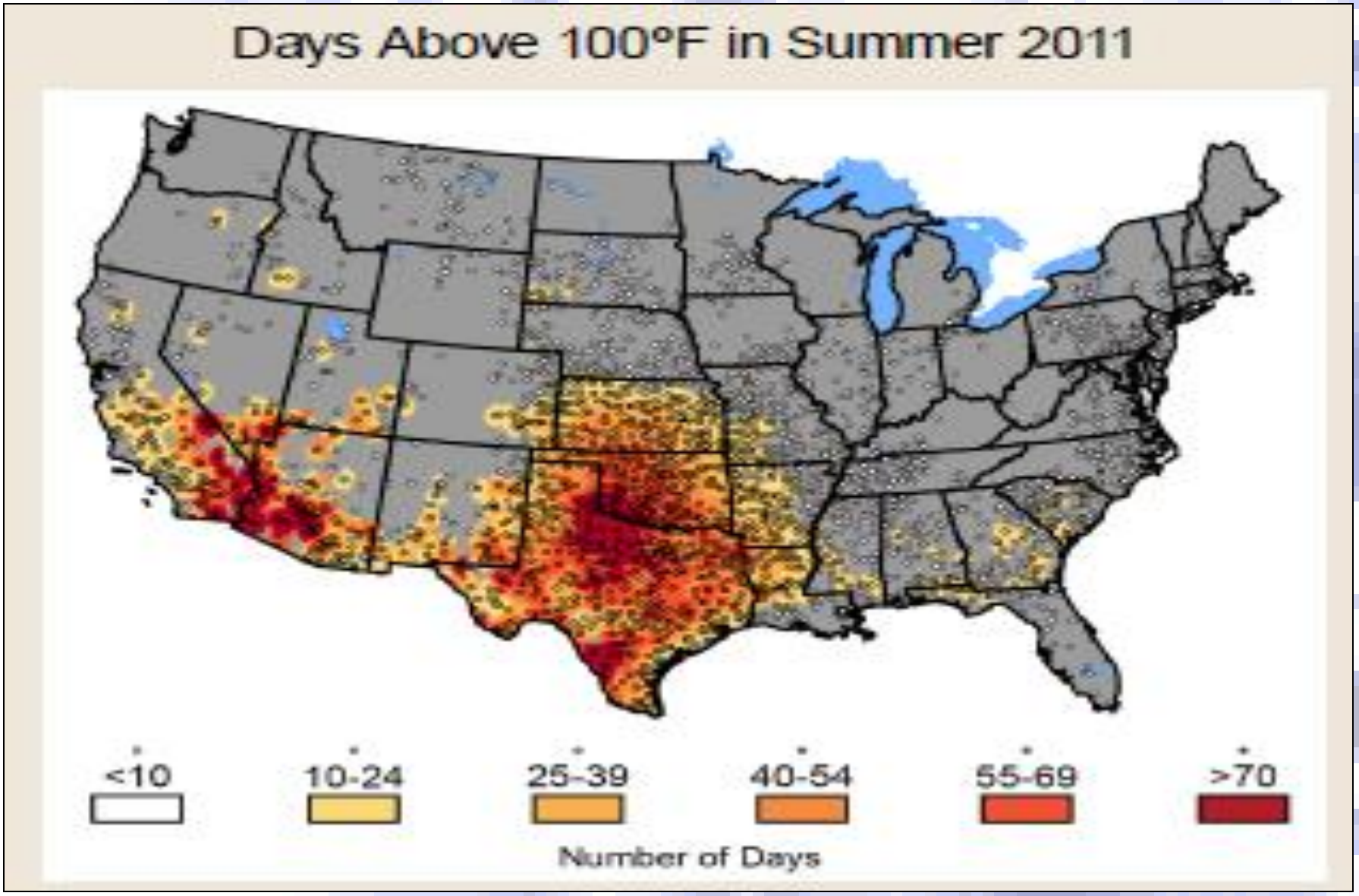


Historical Temperature on the 7 Warmest Nights of the Year

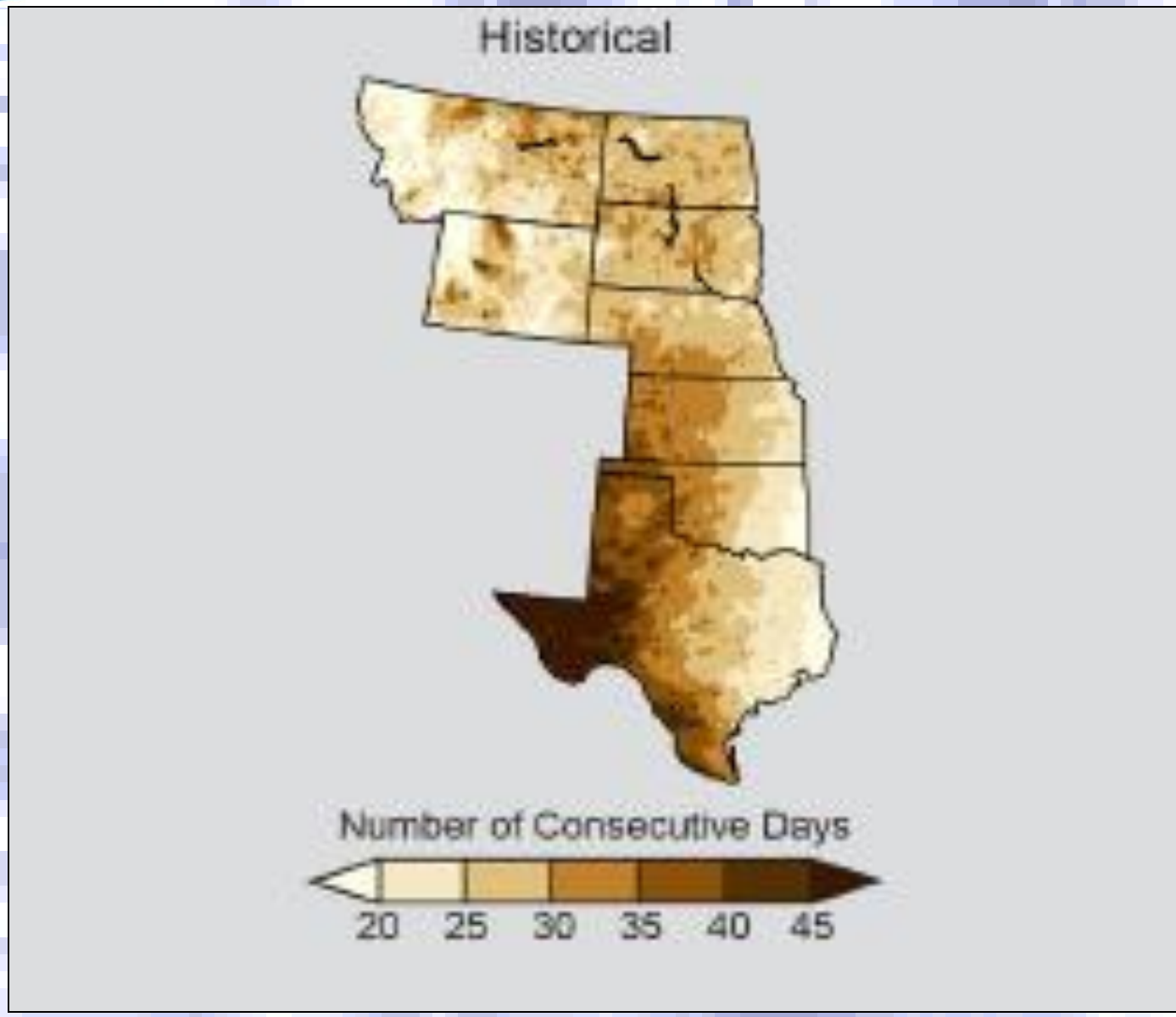


20 – 40 More Warm Nights

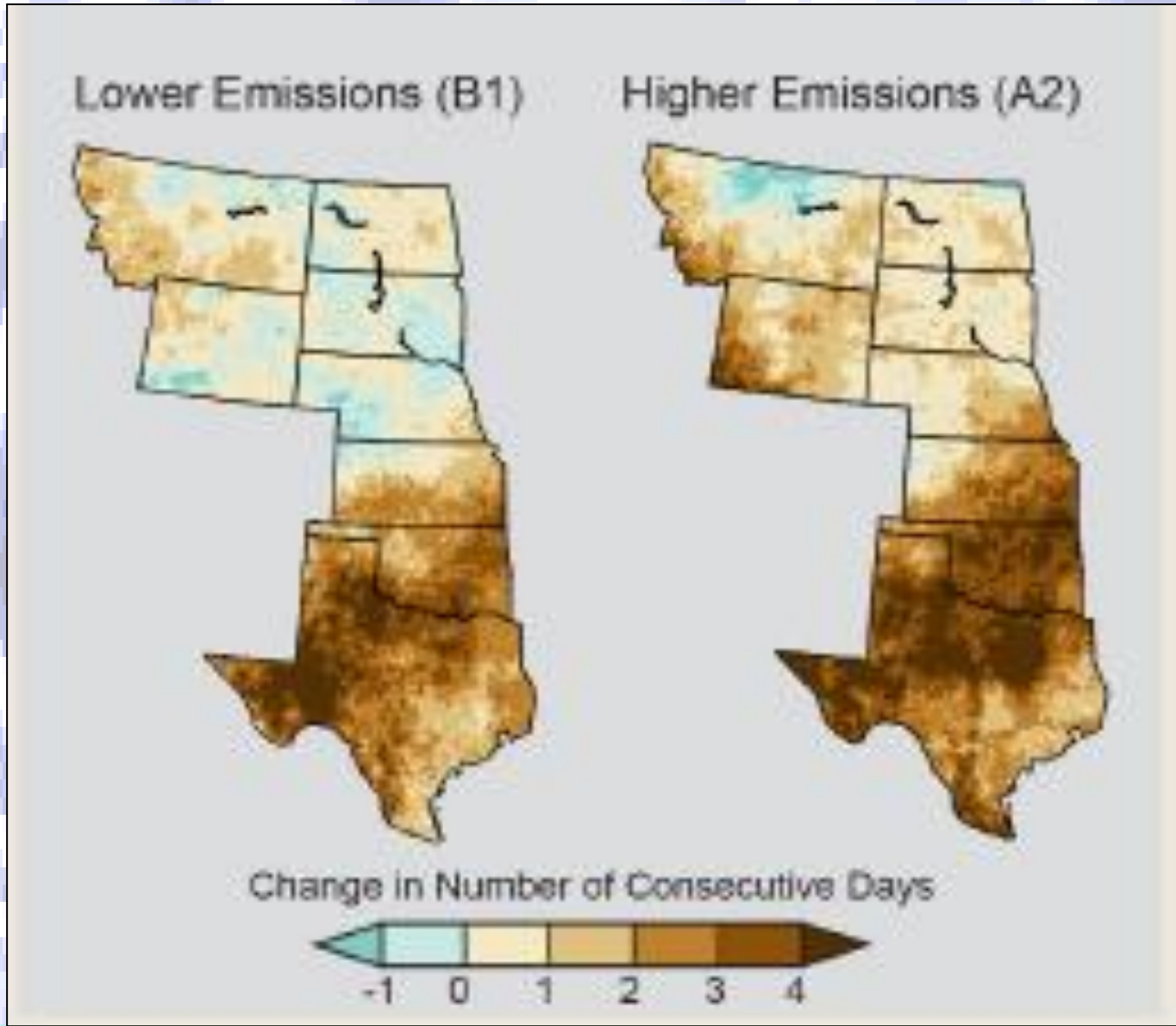



Days Above 100°F in Summer 2011
<10
10-24
25-39
40-54
55-69
>70
Number of Days

Historical Number of Dry Days



2 – 7 More Dry Days



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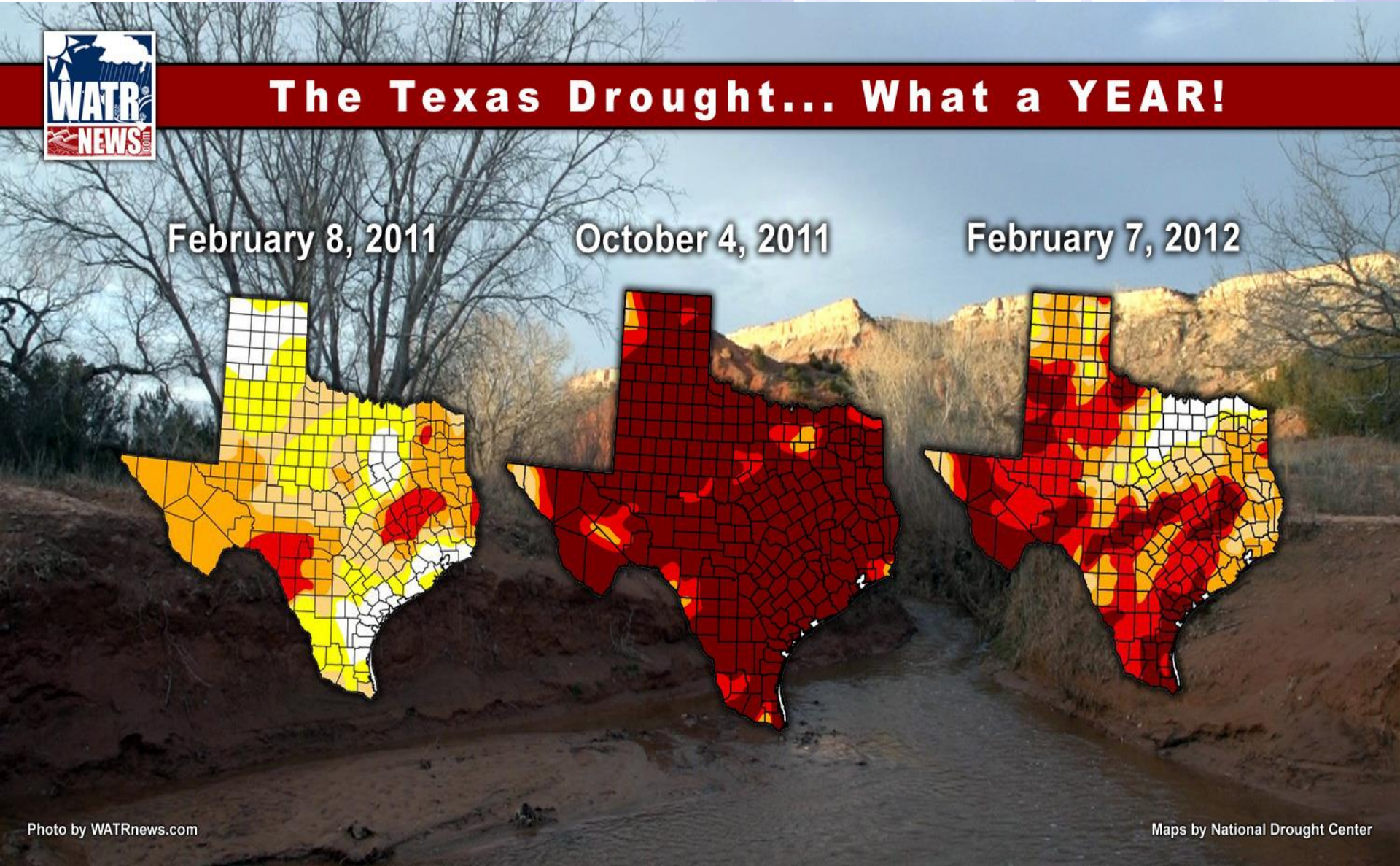
The Texas Drought... What a YEAR!




No
Fishing
In
Harbor


AP

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So why is all of this important to me?

And what does Climate Change have to do with water quality anyway?

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Climate Change Impacts on Water Resources

- Increased Water Demand
- Higher Energy Demand (power plants, drilling, fracking)
- Agricultural (longer growing seasons, more irrigation)
- Higher Evaporation Rates
- Increased Demand for Groundwater Supplies
- Ecological/Biological

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Impacts on Water Quality

- Receiving waters become dominated by Effluent flows
- Increased Nutrient concentrations
- Increased Sediment concentrations from extreme events
- Longer contaminant residency times due to reduced stream flow

Predictions vs. Reality

2014

Cypress Creek Basin Summary Report

Texas Clean Rivers Program

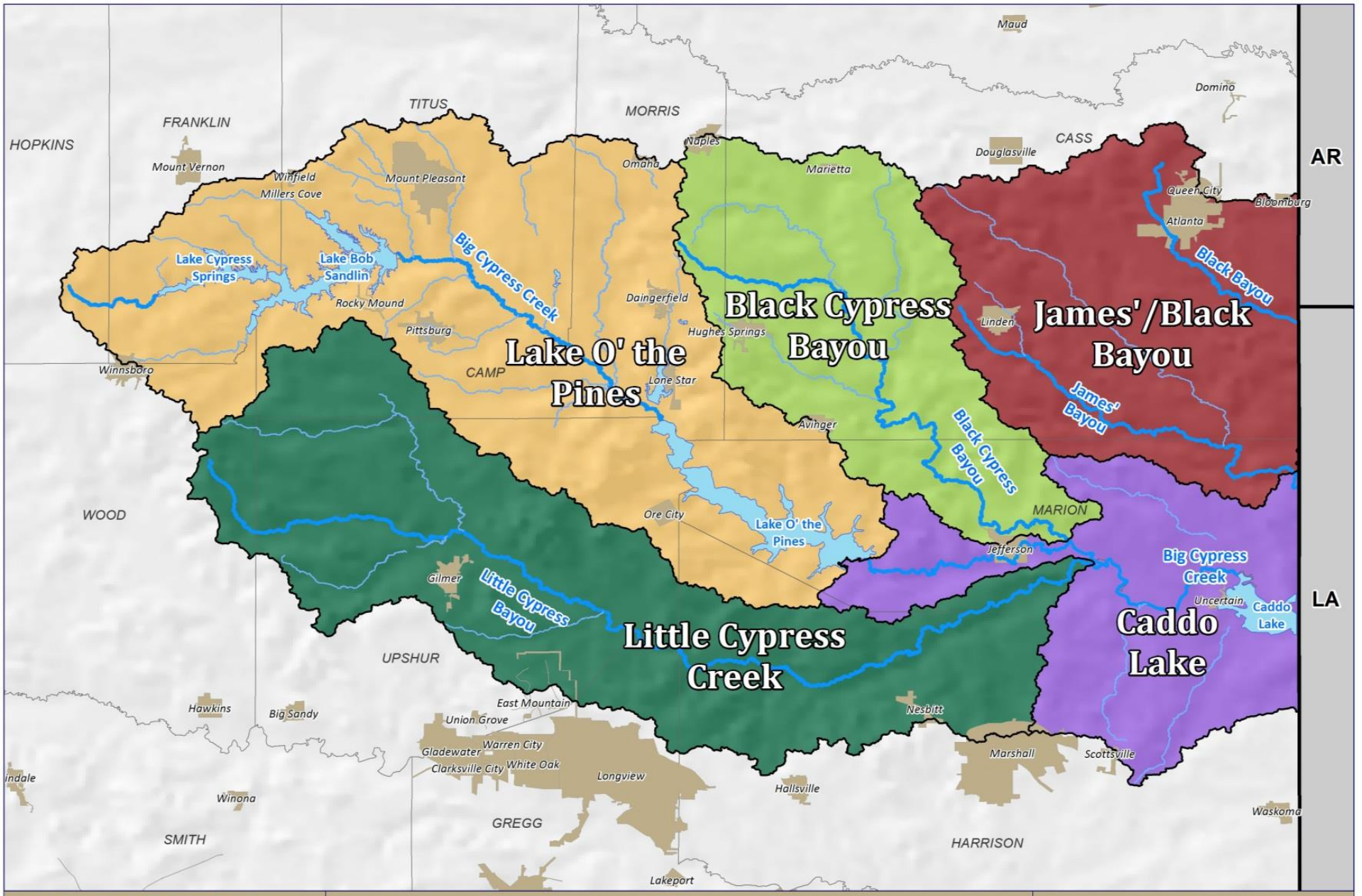
This report was prepared by Water Monitoring Solutions, Inc. for the Northeast Texas Municipal Water District in cooperation with the Texas Commission on Environmental Quality

Our Mission:
The mission of NETMWD is to protect the water quality in the Cypress Basin and to provide a sufficient supply of water to Northeast Texas.

PO Box 955
Hughes Springs, TX 75656

Phone 903-639-7538
www.netmwd.com

The preparation of this report was financed through grants from the Texas Commission on Environmental Quality



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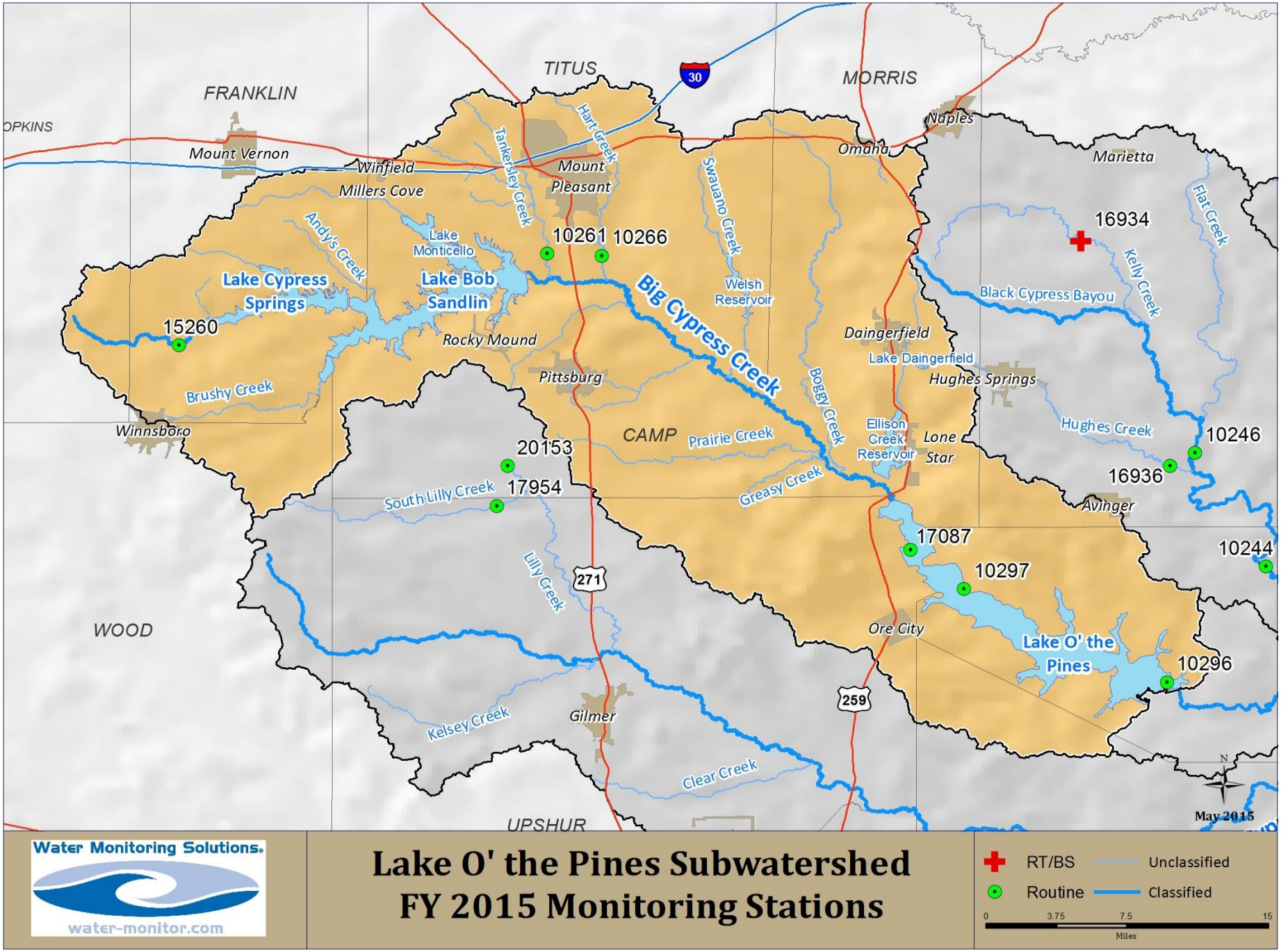
Cypress Creek Basin Subwatersheds

February 2014

N

0 5 10 20

Miles


TITUS
MORRIS
FRANKLIN
OPKINS
30
Mount Vernon
Winfield
Millers Cove
Tankersley Creek
Hart Creek
Mount Pleasant
Naples
Omaha
Marietta
Flat Creek
16934
Kelly Creek
Black Cypress Bayou
Swauano Creek
Welsh Reservoir
10261
10266
Lake Monticello
Andy's Creek
Lake Cypress Springs
Lake Bob Sandlin
Big Cypress Creek
15260
Rocky Mound
Daingerfield
Lake Daingerfield
Hughes Springs
Pittsburg
Brushy Creek
Boggy Creek
Winnsboro
CAMP
Prairie Creek
Ellison Creek Reservoir
Lone Star
Hughes Creek
10246
20153
16936
South Lilly Creek
17954
Greasy Creek
Avinger
17087
10244
Lilly Creek
271
10297
WOOD
Ore City
Lake O' the Pines
10296
259
Kelsey Creek
Gilmer
Clear Creek
UPSHUR
N
May 2015
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Lake O' the Pines Subwatershed
FY 2015 Monitoring Stations
RT/BS
Routine
Unclassified
Classified
0
3.75
7.5
15
Miles

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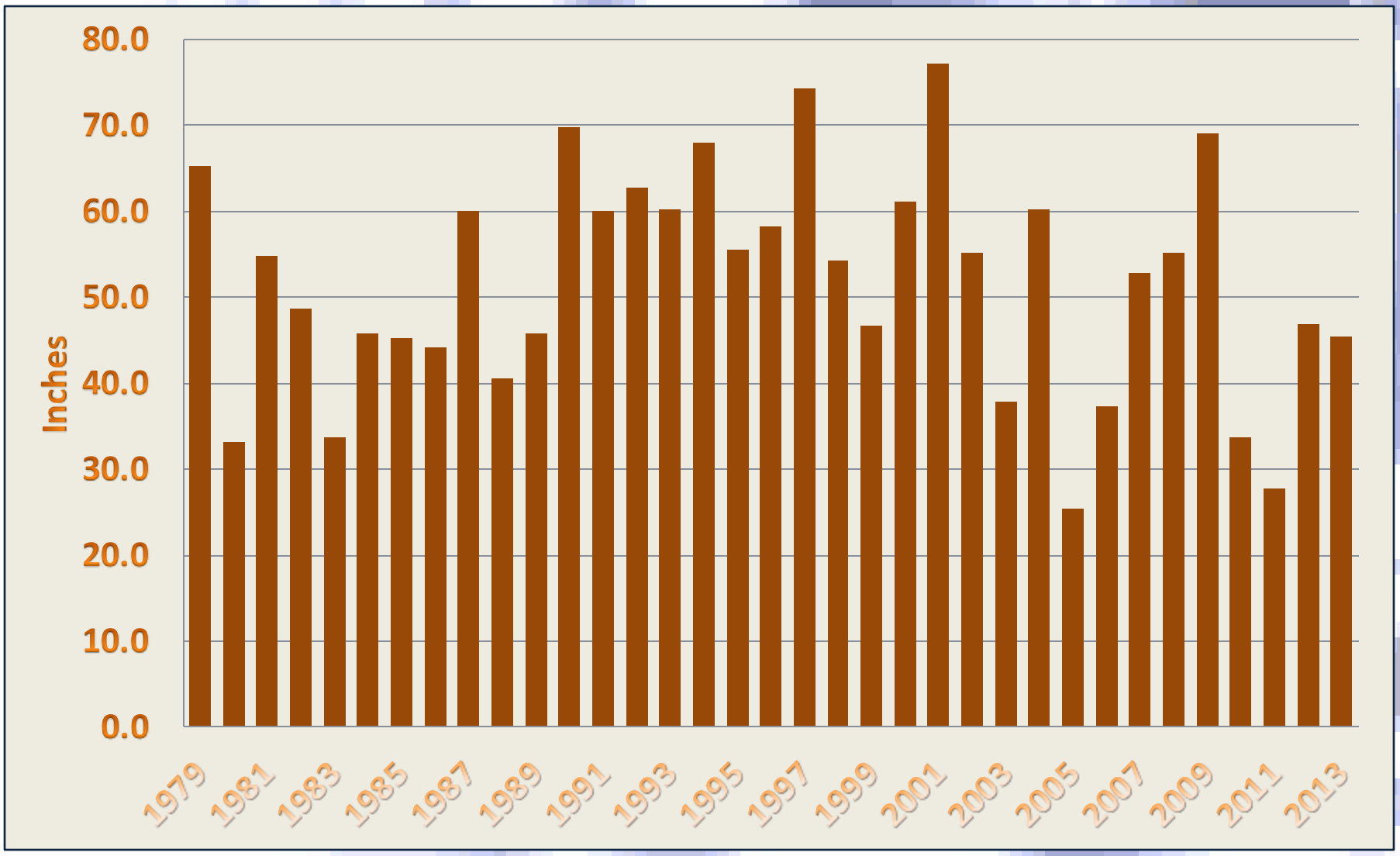
LBS Rainfall Records



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Lake Bob Sandlin

- Average Rainfall (1979-1998) 54.0″
- Average Rainfall (1999–2013) 48.8″
- Four of 6 Driest Years:

  2005*, 2006, 2010, 2011

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Lake Bob Sandlin

- Average Release (1979-1998)
  >100K ac-ft
- Average Release (1999–2013)
  66K ac-ft
- No Releases since April 2010

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Average Specific Conductance (µS/cm)

Tankersley		Hart		Big Cypress			
10264	345	10273	275	10310	792	**Walkers**	
10263*	1146	10272	263	10308	602	16454	141
10261	923	10266*	329	13631	332		

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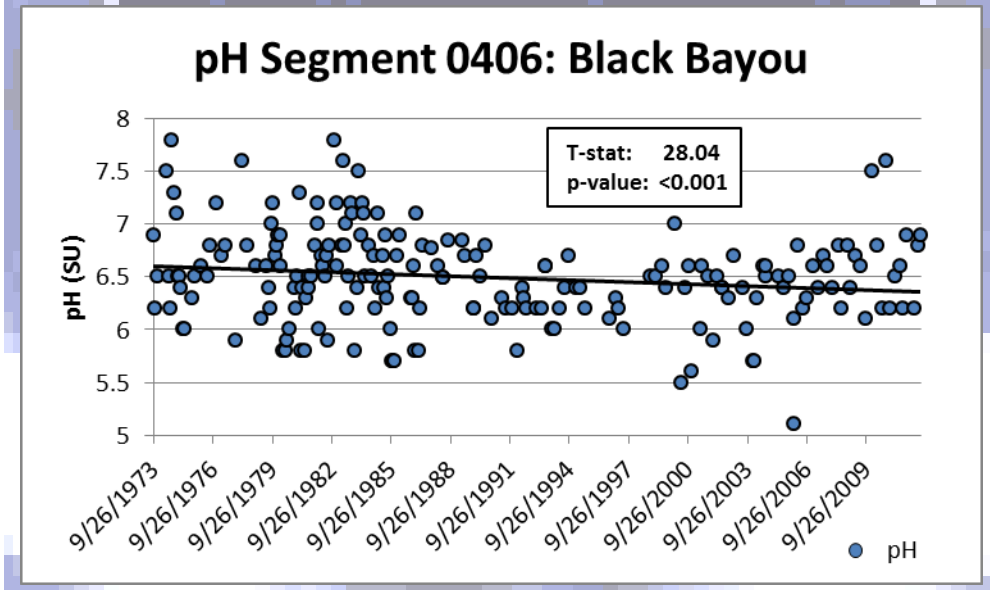
Trend Analysis

- Criteria for trend analysis
  - 10 years of data (minimum)
  - Regular sampling scheduled
  - Minimum 20 to 30 data points
- Type of analysis
  - Linear regression
  - T-stat >=|2|
  - p-value of < 0.05
  - 95 percent confidence interval
- Trends
  - Mean, median, and standard deviation
  - Variability shown by standard deviation divided by the mean and expressed as a percentage



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Results

Specific Conductance/Total Dissolved Solids Increasing in Watershed

- Lake Cypress Springs
- Lake Bob Sandlin
- Big Cypress Creek below Lake Bob Sandlin
- Lake O' the Pines
- Caddo Lake

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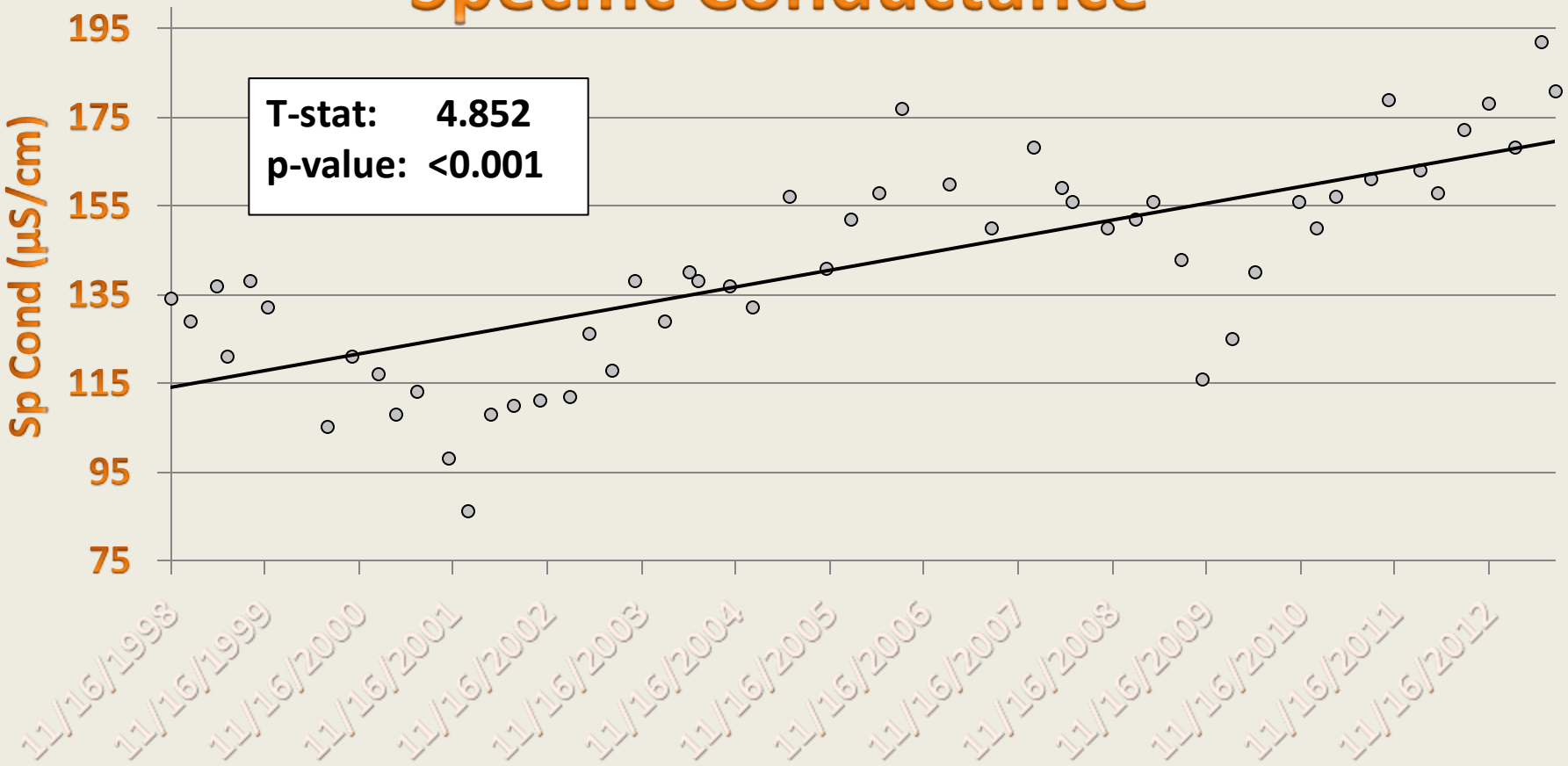
Lake Cypress Springs
Specific Conductance



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Significant Trends

Segment	Station ID	Sp Cond/ TDS	DO	pH	Secchi	Chlorophyll a	Total Phosphorus
Lake Cypress Springs	10313	↑					
	10312	↑					
Lake Bob Sandlin	16158	↑					
Big Cypress Creek Below Lake Bob Sandlin	10308	↑		↑			↑
	13631						↑
Lake O' the Pines	10300				↓		
	10297						
	16156	↑					
	10296	↑				↑	
Big Cypress Creek Below Lake O' the Pines	15511			↑			
	10295	↑					
Caddo Lake	15249	↑					

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Results

- Increasing Phosphorus trend in BCC below LBS
- Increasing pH trend in BCC below LBS
- Increasing Chlorophyll *a* trend in Lake O' the Pines

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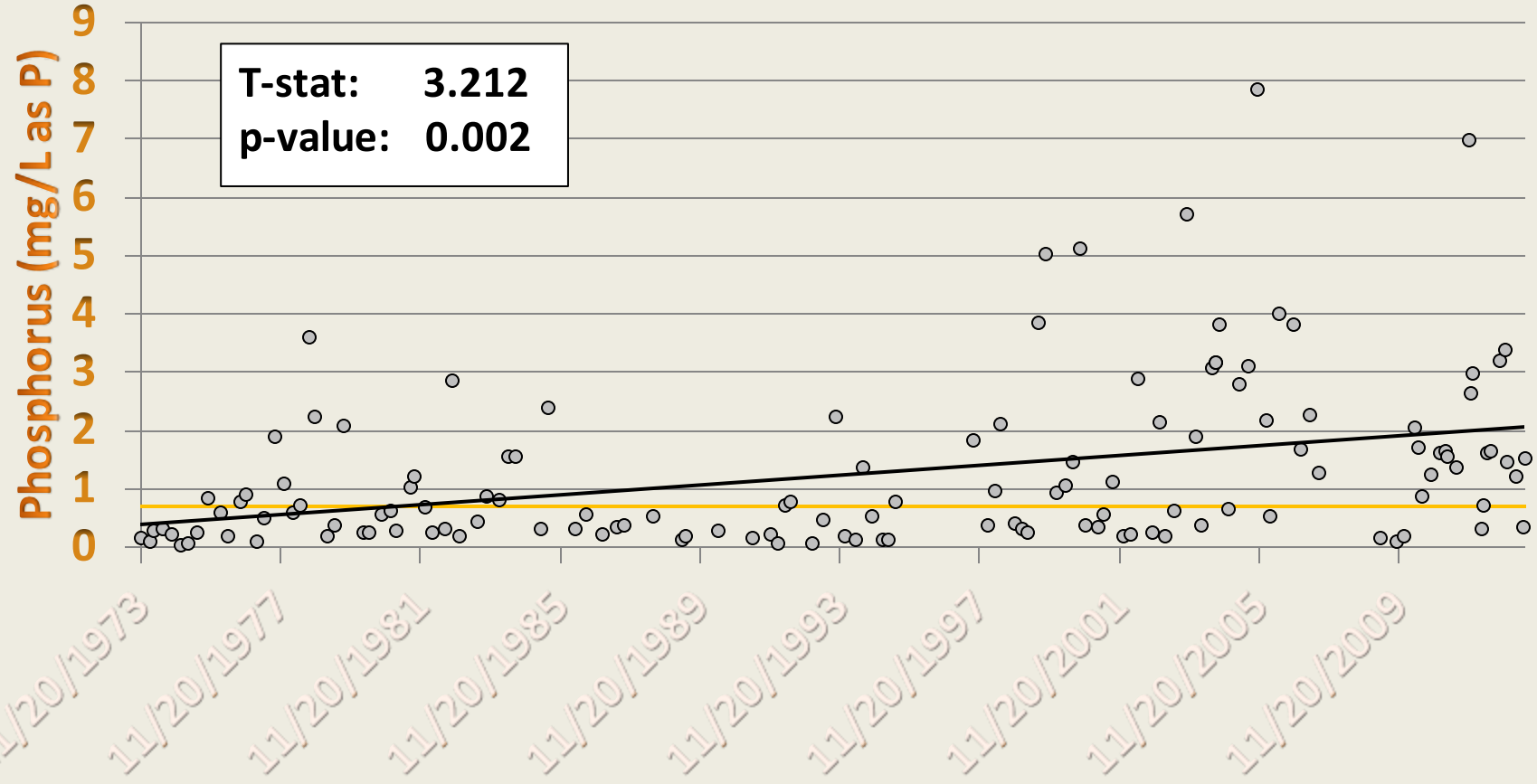
Big Cypress Creek below Lake Bob Sandlin
Total Phosphorus



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Conclusions

- Phosphorus in Segment 0404 is leading to increased chlorophyll in Lake O' the Pines
- Increasing pH in BCC below LBS likely due to nutrient inputs and lack of fresh water in-flow
- Reduced annual rainfall and lack of releases from LBS causing increasing conductance

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Conclusions

- Climate Change is having a negative impact on Water Availability in the Cypress Creek Basin

- Measurable Water Quality changes to BCC and LOP

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Future Study

- Long-term Impacts to biota?
- Long-term effects to Water Quality of Lake O' the Pines?
- Similar trends in other basins?

QUESTIONS?

For Additional Information:

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Trend Analysis

Segment Name	AU	Parameter	Date Range	# of Data Points	T-stat	p-value	Trend Direction
Lake Cypress Springs (0405)	01	Specific Conductance	11/98 - 8/13	54	-5.035	<0.001	↑
	02	Specific Conductance	11/98 - 8/13	55	-4.852	<0.001	↑
Lake Bob Sandlin (0408)	03	Specific Conductance	11/98 - 7/13	57	-4.939	<0.001	↑
Big Cypress Creek Below Lake Bob Sandlin (0404)	02	Specific Conductance	9/73 – 7/13	225	-2.508	0.013	↑
		pH	9/73 – 7/13	218	28.04	<0.001	↑
		Phosphorus	11/73 – 7/13	133	-3.212	0.002	↑
	01	Total Organic Carbon	10/79 – 7/13	121	5.818	<0.001	↓
		Phosphorus	10/79 – 1/13	117	-3.818	<0.001	↑
Lake O' the Pines (0403)	04	Transparency	10/03 – 8/13	34	4.147	<0.001	↓
	02	Specific Conductance	1/99 – 8/13	68	-5.010	<0.001	↑
	01	Specific Conductance	10/73 – 8/13	127	6.645	<0.001	↑
		Chlorophyll *a*	11/73 – 4/13	113	-3.960	<0.001	↑
Big Cypress Creek Below Lake O' the Pines (0402)	03	pH	11/98 – 7/13	58	3.463	0.001	↑
	01	Specific Conductance	9/02 – 8/13	77	-3.025	0.003	↑
Caddo Lake (0401)	07	Specific Conductance	10/00 – 8/13	200	-4.212	<0.001	↑
Segment 0406: Black Bayou	01	Specific Conductance	9/73 - 7/12	198	4.496	<0.001	↓
		Dissolved Oxygen	9/68 – 7/12	239	8.404	<0.001	↓
		pH	9/73 – 7/12	199	28.04	<0.001	↓